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MEMORANDUM FOR THE RECORD

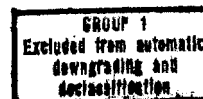
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Following in reverse chronological order will be brief summaries of visits primarily to various government installations made in support of the NPIC/TDS Human Factors Contract during the last four months. Inquiries as to further details of the programs discussed may be directed to the author.

1. On 17 February, the most recent of several discussions with [redacted] of the Army's Personnel Research Office occurred. APRO and particularly [redacted] have long been associated with the field of tactical image interpretation research, and as far as selection and training of operational p.i.'s is concerned, they probably have no peers. Obviously the NPIC environment is extremely different from that with which APRO deals, but the question at hand is whether this discrepancy dictates that research must be duplicated for NPIC's specific purposes. Wherever possible we should attempt to adapt APRO's proven efforts to our situation. The validity of such translation, of course, must be thoroughly explored. NPIC's uniqueness of scale, targetry, mission, personnel requirements, etc. will undoubtedly earmark much of APRO's work for substantive rejection. Even so, we should be able to learn significant lessons concerning experimental and theoretical methodology from this experienced applied psychology-oriented organization. Past and present APRO efforts on image quality, team procedures, and perceptual learning also bear careful coordination with our Human Factors program. The often-cited chasm between tactical and strategic image interpretation should be investigated intensively and either confirmed or dismissed item by item. [redacted] is willing and eager to cooperate with us and with [redacted] in a concerted effort to achieve such a much-needed definition of terms. He now possesses a continuing ad hoc Agency SECRET clearance on the basis of his DOD TOP SECRET and may be

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the 544th Aerospace Recce-Tech. for whom the system will eventually be used). Probable display capabilities will include at least the facility for reduced resolution presentation of the imagery on the CRT, overlain by COMOR target charts, maps, symbols of previous status, etc. [redacted] is the systems contractor, with [redacted] as a Software sub. The overall goal of the PACER effort is considered to be the sizable increase in actual photo interpretation via a dramatic decrease in time spent on collateral retrieval.

3. On 9 February, the North American Air Defense Command's Combat Operations Center in Cheyenne Mountain near Colorado Springs was visited. Unfortunately, the very generalized orientation briefing did not allow for detailed technical exchange, but groundwork was laid for a return visit to discuss a visual display system possibly even more versatile than the previously described VASS at SAC. NORAD's use of this console, believed to be manufactured by [redacted] is for the retrieval of strategic intelligence primarily in the form of aircraft, missile, and satellite electromagnetic signatures. The intriguing number of 53,000 alternative video displays was mentioned as selectively recallable within ten seconds of operator request. Priority transferral of the individual console information to a 20 foot square, 7 color, filter-controlled, rear projection command screen is accomplished through a system of weighing confidence level against contextual intelligence importance. [redacted] CIA liaison officer at NORAD, will arrange any future investigatory conferences with the appropriate T-KH cleared NORAD personnel.

4. On 23 January, the orientation session for an Agency-sponsored training seminar in programmed instruction was attended. Guest lecturer was [redacted]

[redacted] spent the morning recounting the history and development of instructional technology and programmed instruction (p.i.) in particular. He also described the basis for p.i. in the psychology of learning and how the principles of learning are applied to the instructional environment.

Programmed instruction, it was pointed out, had its roots planted as far back as the 1930's when several educational psychologists recognized the key role which feedback plays in the learning process. The present "movement", however, was heralded by the publication in 1954

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submitted for T-KH-SI clearances in the near future. The close proximity of both APRO's interests and physical location to those of the Center would seem to urge considerable coordination.

2. On 10 February, Strategic Air Command Headquarters at Offutt Air Force Base in Omaha was visited regarding the RADC-researched "PACER" programs. [] at Rome, who is chiefly responsible for PACER's development, had previously recommended the visit to SAC where the program is being implemented. "PACER" is an acronym for Program Assisted Console Evaluation Review and has been in the R&D process for about three years. In essence, it is an adaptation to photo interpretation of an extremely sophisticated collateral retrieval system currently being employed in the SIOP (Single Integrated Operational Plan - SAC's War plan). At present, PACER is still in the planning stage, with hardware delivery not expected until October '67 and evaluation scheduled to commence in April '68. Its operational predecessor, known as "VASS" (Visual Analysis Subsystem) is functioning successfully for SAC's Targeting Section, adjacent to the underground Command Post. A sterilized demonstration of the VASS was given by [] Chief of the Intelligence Directorate's Targeting Division. (An ESI clearance for "Extremely Sensitive Information" is required for complete access to the SIOP and the National Strategic Target Data Base therein.) At the heart of the VASS is a [] Visual Analysis Console connected to a versatile [] computer. The [] allows any one of 100 film slides from a random access file to be rear-projected onto a CRT screen, with electronically generated alpha-numeric and graphic displays superimposed on the projected image. The composite image may be hard-copied or stored for future recall in the 65K computer. Real time mensuration is accomplished on the CRT with an input light pen. [] Chief of the Systems Division's Automation Branch, and [] the project engineer, explained that PACER as an adaptation of VASS is still not yet fully designed. Especially critical areas yet to be defined include the finalizing of an interpretation collateral call-up package and its querying parameters. Also yet to be answered is the question of where to present the actual reconnaissance imagery (T-KH material in the case of

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of Principles of Learning and in 1958 of Teaching Machines, both by B. F. Skinner of Harvard University. The military led the sponsorship of p.i. research beginning in 1959 after what in 1958 amounted to American education's sharpest spur ever, the launch of the Soviet Sputnik. Since then, much innovation in training methodology has been recommended by experimental findings, but as [] aptly put it, the instituting of educational reform "is like moving a cemetery". The basic nature of learning as an environmental molding of simple to more complex concepts was discussed. The fundamental steps along the way to all comprehension are response, reinforcement, stimulus control, and self-pacing. Skinner, in fact, maintains that apparent individual differences in intelligence are actually discrepancies only in the rate at which one learns. A currently controversial question among educational researchers is what role error-making plays in learning. The time-weary comforter that one learns by his mistakes is being challenged by numerous studies which show terminal behavior unchanged after error committal.

The plaudits of programmed instruction have been many and varied. Its elimination of the need for constant interaction with the teacher is one significant, man-power conserving advantage; then too there is the flexibility through branching programs for students of varying abilities to absorb information at their own personal rates; additionally, p.i. facilities accelerated and more readily retained learning because of its dictation of controlled, small but complete, behavioral steps. A typically-cited achievement for p.i. is the 30% reduction of learning time required for the chemical element symbols, along with increased retention of the code.

Programmed instruction, [] reported, is certainly not without its unsolved problems. Motivation maintenance is one feedback to the learner of successful performance is a partial answer, but such reward may not be sufficient. Another is the role of punishment failure experiences are known to damage learning in some cases, but are also known to promote defense development, so some tradeoff must be reached. Probably the greatest dilemma faced by educational technology today in connection with p.i. is the question of the need for overt response for learning to progress. That active student participation is essential is well-documented, but the possibility of covert, mental rehearsal's being sufficient as opposed to overt, written responding is ever more apparent.

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See previous memorandum for speculation as to possible NPIC uses of programmed instruction. [] are currently under contract to OTR to assess recent advances in educational technology in light of Agency requirements, but little direct consideration of NPIC needs has yet been given.)

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5. On 17 January, [] was visited regarding human factors considerations in the design of optical instruments for photo interpretation. A meeting was held with []

[] The conclusions reached were extremely disappointing and, in general, may be summarized as confirming the vast void existent in the area of research on the interaction between man and optical machine. Although [] possesses a visual instruments r&d group headed by [] and a biophysics group headed by [] little effort has been made to define and standardize optical design as dictated by human requirements. Visual parameters such as accommodation and convergence are treated as virtually random variables whereas, in fact, their mishandling may prove to be physiologically harmful to instrument operators. Comfort, safety, fatigue, and performance are names dropped only in passing, and an endeavor to correct this gross injustice still carries little priority within the company. It is quite apparent then that NPIC/TDS should undertake as soon as possible a program to adequately treat this long-neglected but crucial area of immediate influence on future equipment development.

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6. On 16 January, Rome Air Development Center at Griffiss Air Force Base was visited regarding the previously reported PACER program. [] EMIR Chief, Expressed extreme enthusiasm about the RADC-SAC project and was completely candid about its details. Willingness to discuss it thoroughly with NPIC representatives was relayed. Interpreter/machine dynamics as confirmed at Omaha was ascribed as the largest remaining area for continuing PACER research.

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7. On 12 January, a human factors colloquium on real time reconnaissance was attended at the [redacted]. Although hosted by [redacted] the meeting was actually sponsored by ARPA and was chaired by [redacted] of that Agency. [redacted] opening remarks emphasized that the military is quickly realizing the importance of the human in tactical reconnaissance systems and the advisability of designing new machines around the man rather than vica versa as in the past. [redacted] punctuated the introductory comments with the observation that some aircraft display designers are presenting interpreters with situations "no better than upside-down newspapers".

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The first paper was presented by [redacted] and was entitled "Recognition Performance". The effects of sensor equipment variables was the first topic discussed and included an allusion to an improved CRT display via a vertical rather than a horizontal raster. Non-equipment variables were next treated. Briefing level was cited as a critical predictor of recognition performance in the tactical situation, and oblique photography was attributed much more effectiveness for pilot target briefing than vertical. Concentration on target surroundings such as road patterns rather than target characteristics themselves was also shown more desirable. Finally, an analytical computer modeling technique for recognition system assessment was described.

[redacted] next talked on "Direct Visual Surveillance". He described a program to determine eyeball efficiency in a "total search" environment. A large terrain model is being used for target acquisition simulation for visually-guided missiles as well as for low level reconnaissance.

[redacted] then delivered a very controversial paper entitled "Matching the Characteristics of a T.V. System to those of the Human Eye" along with a supportive piece, "Measurement of the Direction of Pointing of the Eye." What [redacted] proposed was a bizarre servomechanism-oculometer-video screening

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system whereby high acuity foveal vision would be used by the observer to the exclusion of peripheral. Without recounting the seemingly unwieldy situation of translating a T.V. set through space at the same angular rate as the eye, several perceptual phenomena would seem to immediately preclude the development of such a system: first of all, the fact that stabilized retinal images rapidly fade from view is well known - natural, microscopic eye movements serve to continually excite alternate visual receptors for maintained image perception; secondly, because larger eye movements initiate a coincident blanking of vision so that the visual world doesn't jump each time we re-fixate, interference with this process would surely have disastrous consequences; thirdly, although the acuity of foveal or central vision decreases rapidly in the periphery, the role of peripheral vision in search and detection is incontrovertible although poorly understood; eliminating peripheral functioning would probably result in a paralyzed stare.

The next paper presented was on the "Night Life Simulation Program" being undertaken at [] for ARPA. [] described this effort involving simulation of real time night video reconnaissance through the use of a stoppable frame CRT presentation of Ampirt (South-east Asian Tactical) imagery. Primary targets for detection were human figures of various cross-sections depending upon ground position. Three phases of the study were described in which separate experimental variables were manipulated - scale factors and frame time, electro-optical factors, and team procedures. The results obtained to date include indications of an optimum framing time of ten seconds, little enhancement possibility at the video monitor, and 50% increase in total target detection by using two independent observers.

The next paper, "Simulation at []", was presented by Mr. [] They described their ACTRESS (Active Reconnaissance System Simulation) facility and their participation in the Air Force's "Shed Light" program of real time reconnaissance research. Much of the work revealed was similar to that described previously by [] Most stimulating aspect of this presentation was a furious debate it touched off on imagery resolution. The question of object major versus minor dimension as the criterion for required resolution for detection was discussed but not resolved. The physicists present seemed to lean toward the minor

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dimension as more critical while the psychologists defended the major.

25X1 [] next reported a "Pilot Study on De-
tection of Human Beings with T.V." Ground as well as aerial imagery was
employed. Conclusions reached included the following: that observer
search time decreases with increasing target size; that search time de-
creases with increasing target size; that search time decreases with
increasing display brightness at a constant target size; that detection
efficiency is improved in color over black and white photography. Dr.
25X1 [] of RADC confirmed [] findings for photo inter-
preters in his experimentation. Completeness, accuracy, and speed of
intelligence extraction from color aerial imagery are all improved over
black and white, he stated.

25X1 The following paper entitled "Status Review - Detection and Recog-
nition of Targets" []

25X1 [] Several [] programs of possible direct NPIC
interest were discussed. The first was a real time [] target acquis-
tion study for the Navy in which both sensor parameters and interpreters'
25X1 reference materials [] are being assessed for
effectiveness. Mention was also made of a second study of [] target
recognition involving varying display format size and varying [] reso-
lution per specific targets such as railroad yards, SAM sites, POL stor-
age, etc. [] imagery is being employed primarily plus []
25X1 [] real array material at a quoted 15 foot ground resolution. One
25X1 conclusion already reached from such studies is that a continuously mov-
ing display is 1½ to 3 times better for real time reconnaissance than
a sequential presentation, with terrain and time held constant.

25X1 [] next discussed "High Speed Low Altitude
Reconnaissance Detection Data" resulting from the Joint Task Force II
work now ongoing at [] One of the most important con-
25X1 clusions of these studies has been the repeated confirmation of target
surround as the most critical detection criterion in a speed-controlled,
near threshold, visual acquisition environment. Aircraft velocities of
up to Mach 1.2 are simulated at altitudes of 200 to 400 feet above the tra-

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versed terrain. Complete documentation of these JTF II studies is available in NPIC/TDS.

The final paper of the colloquium was presented by [redacted]. It concerned an "Analysis of Tactical Real Time Recce Limitations of Resolution as a Function of Angular Rate". The difference between the resolution requirements for target recognition or identification as opposed to simple detection was discussed at length. Ten resolution elements was quoted as mandatory for the former task whereas only four are sufficient for the latter, under normal conditions. An angular velocity of greater than one radian per second was cited as being deleterious to dynamic visual acuity. Numerous tactical targets have been considered in the present studies, [redacted] reported, with recognizability being plotted as a function of velocity to altitude ratio of the sensing aircraft as well as of elevation angle of the aircraft from the acquired target.

8. On 16 December, an exploratory visit was made to the Office of Naval Research. Contacted there on an unclassified basis was [redacted] Head of the Engineering Psychology Branch of ONR's Psychological Sciences Division. (The three other branches in this division are concerned with physiological psychology, group psychology, and personnel and training.) [redacted] reported that little if any photo interpretation research is being sponsored by ONR, but that many human factors efforts in related areas would probably be of significant interest. Such NPIC-relevant topics as vigilance, decision-making, memory, visual search, image enhancement, performance measurement, display optimization, computer and program assisted instruction, and target recognition are being treated at ONR. Such prominent contractors as [redacted]

[redacted] are being supported in engineering psychology projects. At first glance, ONR appears to possess one of the most well-rounded research programs in the government. Its balance between the basic and the applied disciplines within the psychological sciences especially is highly commendable. NPIC's human factors program unquestionable can gain much valuable direction from [redacted] and his associates. Both desire and willingness to cooperate with us has been expressed openly by several ONR representatives.

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25X1 9. On 5 December, the U.S. Naval Aerospace Medical Institute at Pensacola, Florida was visited regarding research being conducted there on human vision. [] head of the Physiological Optics Branch, was contacted. As far as the Navy is concerned, [] visual research is directed mainly toward pilot selection and training, but his primary current work is actually connected with astronaut environmental training. This latter effort is sponsored by NASA under an inter-agency personal services contract with the Navy. [] is considered an expert on the vestibular (balance) sense and is also engaged by the Air Force as a bioastronautics consultant to the MOL program. In connection with this assignment, a particular interest was expressed in discerning experimentally the unique visual attributes possessed by superior photo interpreters. As yet unpublished work conducted by [] reveals that a distinct correlation exists between students' physiological visual measurements and their performance in flight training. [] present assignment has involved the administration and evaluation of the individual components of various visual test batteries including the measurement of phoria, retinal rivalry, size constancy, perceived form, and memory span. He was extremely willing to help us construct or critique any interpreter visual examinations.

25X1 10. Also on 5 December, the U.S. Army Aerospace Medical Research Unit at Fort Rucker, Alabama was visited briefly. [] the commanding officer, was contacted regarding his unit's work in applied opthalmological research. Areas revealed as of continuing interest and effort at Rucker include color vision, dark adaptation, electroretinography, refractive errors, and eye movements. The unit presently maintains a closely coordinated, cooperative research program with the previously referenced Navy physiological optics group at Pensacola.

25X1 11. In addition at Fort Rucker, [] of the Army's Aviation Human Research Unit was visited. This unit is one of seven field research stations under [] Resources Research Office (HumRRO). [] primary duties are connected with "Task Observe", a project roughly similar to the aforementioned JTF/II high speed visual target acquisition studies, but in the slow speed situation. This effort is being sponsored by Army Intelligence at Fort Holabird. Another program known as "TARS 75" (Tactical Reconnaissance and Surveillance) monitored by [] is being performed jointly by [] It involves the consideration of operational reconnaissance acquisition in terms of its

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man-machine system parameters. Man is treated in his various roles as primary and secondary sensor, controller, and maintainer in order to assess optimum configurations. Reference was also made by Dr.

25X1 [] to a HumRRO project of possible NPIC interest being conducted at Fort Knox. It deals with real-time reconnaissance readout and includes studies of various image intensification schemes.

12. On 30 November at Office of Education Headquarters, a report was heard on the Office of Naval Research program on computerbased instruction. This very informative report was presented by [] 25X1 [], Chief of the Personnel and Training Branch of ONR's previously referenced Psychological Sciences Division. [] began his remarks by maintaining that the concept described by the commonly employed terminology, computer-assisted instruction (CAI), would be better conveyed as "individualized adaptive instruction". Most of ONR's CAI work is contracted out to academic institutions, but some research is also performed in-house. Included among the primary centers of Navy-associated CAI research are [] 25X1 []

25X1 [] BB & N's "Mentor" System was described in some detail. This "quasi-simulation of sequential validity and timing" teaches people to ask questions appropriate to various specific disciplines. The computer assisted technique has already been applied successfully to such areas as criminal investigation, medical diagnosis, business-gaming, and electronics trouble-shooting. Also discussed was the 25X1 []

25X1 [] 125 college level courses have so far been computerized in a sophisticated branching logic mode. Console input buttons include such subject responses as "Yes.", "No.", "Erase.", "Help!", and "Aha!" An additional major ONR-sponsored CAI project is called SLASH, for Studies, Library, Assist, Software, Hardware, and is ongoing at the General Learning Corporation. The training of CAI personnel, the encouraging of CAI research, and the coordinating, developing, and supervising of CAI

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programming are being undertaken. The resources of many widely separated contributors to this program are under local control, but total information retrieval capability is being centralized. Naval applications envisioned for computer assisted instruction include training (laboratory, homework, shipboard technical - proficiency maintenance), education (NROTC, OCS, War College, Naval Academy, on-site refresher courses), and personnel utilization (instruction and assignment geared more closely to personal potential). Anonymity of learning was also pointed out as being a distinct advantage of CAI for the likes of the Joint Chiefs (who are already supposed to know everything) and for "certain security agencies" (who ordinarily find cover mechanisms somewhat cumbersome in such circumstances):

13. On 28 November, the Decision Sciences Laboratory of the Air Force's Electronic Systems Division at Hanscom Field was visited. Contacted there was [redacted] Chief of the Laboratory. DSL has been over the years since World War II one of the Air Force's primary supporters of human factors research. Probably its most renowned effort has been the sponsorship of [redacted] decision theorist and war-gamer, [redacted] who for some time has been attempting to simulate automation of the national command-control process. More relevant to NPIC interests, however, has been DSL's research in such areas as visual psychophysics, perception and cognition, learning and training (including programmed instruction), selection and task analysis, display enhancement for photo interpretation, and human engineering. Relevant reports now in possession of TDS include "Form Perception in Video Viewing: Effects of Resolution Degradation, Stereo, and Content on Form Recognition", "A Study of Visual Display Enhancement and Techniques of Color Filtering", and a "Bibliography of DSL Human Factors Research with Abstracts". One of the most interesting things passed on by Dr. [redacted] was the fact that several DSL studies have shown the Minnesota Clerical Test (speed of perception of similarity or dissimilarity in two groups of numbers or letters) to rank extremely high in predictive validity for such Air Force positions as weather forecaster and navigator.

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On the contrary, the Agency's Assessment and Evaluation Staff has eliminated this test from our Professional Applicant Testing Battery (PATB) because of apparent non-correlation with future performance. Another very relevant fact learned from [] was that his laboratory has been involved for some time in the development of programmed instruction for teaching photo interpretation. [], the responsible scientist, was unfortunately unavailable for direct consultation. (The Decision Sciences Laboratory is, for unknown reasons, being disbanded in the near future, but an attempt will be made to maintain contact with its key personnel.)

14. On 27 October and on one other occasion since then, the 3428th Technical Training Squadron of the Air Force's Air Training Command was visited at Offutt Air Force Base. Contacted there was [] commanding officer of the Defense Sensor Interpretation and Applications Training Program (DSIATP), sometimes referred to as the "Advanced P.I. School". [] is responsible for the training of all DOD T-KH level interpreters (except for those assigned at NPIC). He is extremely interested in the selection and training portion of our [] Human Factors contract and has expressed the desire to cooperate fully with us on its implementation. (See previous memorandum further describing the Offutt school and documenting the possibility of NPIC interpreters attending this relevant and well-run p.i. course).

15. On 26 October, USAF Air Training Command Headquarters at Lowry Air Force Base was visited briefly. Also attending this exploratory session were NPIC Training Branch and [] personnel supporting the training research task under our [] Imagery program. Lowry operates the Air Force's basic (non-system) photo interpretation school and is soon to be supported by [] of RADC in a significant training research effort. (Continuing liaison with [] is being maintained on this and other human factors research performed at RADC. His clearance into the T-KH system is imminent.) The Lowry school itself appears to be much less organized and efficient than the Offutt school. Its very elementary curriculum is probably of interest to NPIC only as a possible source of training for completely inexperienced, new personnel.

[]
Development Staff, TDS

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